Efficient Light Control System

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Problem and Objective

- Most LED grow lights are manual
- Inefficient and Inconvenient
- Combine sunlight and artificial light
- Achieve desired luminosity
Visual Representation
High Level Requirements

1. Wavelength of 400-700 nm, maximum of 3500 lux over 12 hours
2. Photosensor accurately measures illumination
3. Covers variety of plants
Original Block Diagram
Changes to the Design

1. ESP32 on the PCB

2. Transistors instead of Relays: cost effective and reliable
Subsystems: Photosensor

Photosensor

U1
BH1750FVI-TR

VCC
YDD_PHOTOSENSE
GND
GND

SCL
SCL
SDA
SDA
ADD
ADD
DVI
DVI
5
6
4
2

8
Wavelength Requirement in Plant Growth

Figure 12: Wavelength vs Normalized Absorbance for Plants
LED Wavelength
Subsystems: Grow Lights

- Microcontroller output
- V_LED+
- V_LED−
Subsystems: Motorized Blinds
Subsystems: Motorized Blinds
Software Structure
Docker

Containerize the application

- Cloud server runs this image
- Independent of development environment
Data Acquisition

Accept light intensity data from the hardware

- Every other 0.1 seconds
- All data were received within 100 ms latency
Decision Maker

Analyze the current status and take an action

1. Calculates target illumination
2. Take an action
   - The system needs more light => open the blind / turn on LEDs
   - The system needs less light => close the blind / turn off LEDs
Target illumination calculation

You can measure the flux density at the tip of the atmosphere by

\[ F = F_0 \times \cos \theta_0 \]
Logic flow when turning lights on
Quick Demo

http://localhost:3000/
Video of Project
Success and Challenges

- Each individual subsystems function
- Integration between software and grow light module
- ESP32 without an antenna had low quality connection
- Failed to have the chip connected to wifi by itself
Conclusion

- Always double check power ratings, ESP32 damaged due to excess current drawn
- Higher quality connectors, better wire management
- Potentiometer to have more adjustability of luminosity
Recommendations for Further Work

● Manufacture a board specifically for LED arrangement
● Clean up wires, reconsider and change the photosensor subsystem
● Add a hanging system to the panel
● Connect ESP32 directly to wifi